

# Wind Power - Frequently Asked Questions

## ◉ What is Wind Power?

It is electricity generated from the wind using a wind turbine. WIND POWER has low environmental impact – it's renewable and produces no emissions or by-products. Wind is abundant, especially in southwestern Minnesota.

## ◉ Where are the wind turbines located?

We currently purchase WIND POWER off turbines located near Fairmont, MN, and near Dexter, MN. These locations have a great wind resource. The turbines feed directly into the distribution system, which avoids the cost and scheduling of using the transmission grid. Minnesota is the ninth windiest state in the contiguous 48 states with WIND POWER potential of 657 billion kWh.

## ◉ How big is a wind turbine?

For a 950 kW turbine, the 15-foot diameter tubular steel tower measures more than 231 feet from the ground to the central hub and weighs 98 tons. On top of the tower rests the 24 tons nacelle, the main body of the turbine that contains the gearbox and generator. The rotor, made up of the hub and three 87-foot long blades, is 179 feet in diameter and weighs 165 tons.

## ◉ How big is the Fairmont wind farm?

A wind turbine, even in the 950 kW size, makes a small "footprint", taking very little land for the tower, but about 100 acres per turbine is required for the wind resource. Generally, five to seven rotor diameters are required for turbine separation, depending on the wind resource. The spacing acreage is needed to prevent power production loss on a turbine that, because of the direction of the wind, is "downwind" of an adjacent turbine. That is, turbines, especially of the 950 kW size and up, extract significant power from the wind. Any turbine that may be downwind and too close to another will not have the wind resource of an obstructed one.

## ◉ How much power does the wind turbine produce?

The turbine's capacity is 950 kilowatts. That's what is called the "nameplate capacity", which is what can be produced in perfect conditions. On an average annual basis, the turbine will produce about 2,700,000 kWh or enough electricity to power about 375 homes for a year (based on an average usage of 600 kWh per month).

## ◉ What components comprise the wind farm?

The major components of the wind plant are the turbine-blade-tower units, a substation and transmission lines. Here's some detail on each:

**Wind turbines:** The basic components of the wind machines include a tubular steel tower, turbine generator located at the top of the tower, housing for the turbine (called the nacelle), three fiberglass blades and the electronic equipment that monitors and controls the machine. The generator is a 950 kilowatt (kW) alternating current (AC) induction generator. It produces power at 600 volts. The machine is linked by an underground wiring system that carries the power from the machine to the wind farm's substation.

**Substation:** The wind farm's substation takes the power generated by the wind turbine and transforms it to a higher voltage for the distribution system. The substation also ensures that the wind turbine power is delivered at standard, consistent voltage and frequency levels.

**Transmission Lines:** Where the electricity meets the transmission network it is transformed to an even higher voltage and sent throughout the regional power grid.

🕒 How does the wind turbine work?

The wind blowing through the turbine blades rotates the rotor much like a child's pinwheel. A gearbox inside the nacelle transfers this mechanical power to the generator that converts it to electrical power. As wind direction changes, the machine rotates into the wind on its axis; this is called the "yaw" control. The turbine has a weather station and computer control system that provides real-time information on wind speed and direction. With this information the computer controls the machine so it always captures the maximum amount of energy from the wind. This ongoing monitoring and adjustment is known as "chasing the wind."

🕒 Wind farms have caused the deaths of many eagles, hawks and other birds in other areas of the country. What steps have been taken to reduce the hazard to birds from its wind turbine? New turbines are designed with bird safety in mind. All of the following measures work together so there is very little impact on the bird population.

1. Larger machines that generate more power mean that fewer machines are necessary than in the past.
2. The machine's blades are larger and designed to spin slowly (15 to 22 rpm), making it easier for birds to see and avoid them.
3. The machines are placed away from edges of bluffs, keeping them out of the flight pattern of migratory birds.
4. The blades are painted with a reflective coating to make them highly visible to birds.
5. Most important, the machines and their towers do not offer birds tempting places to perch. The WIND POWER turbine uses a tubular tower to support the blades and nacelle rather than the older lattice-style tower. Access ladders are placed inside the tower and all power lines connecting the wind machine to the substation are underground. The nacelle top is smooth and does not provide a roosting place. In the past, most bird injuries occurred as birds spotted prey from atop the lattice towers and glided into the path of the rotating blades.

🕒 Why is wind power so appealing?

A number of traits make wind generation an attractive option, but most compelling is its low environmental impact. Wind is abundant, especially in southwestern Minnesota, and inexhaustible and it's a renewable resource that creates no emissions or by-products. Adding to the appeal is the substantial reduction in cost to produce this clean power - from about 40 cents/kWh in 1979 to 4 to 6 cents/kWh today. Costs to produce wind power are projected to drop even further.

- ◉ Why does wind power cost more to generate?  
Even though there are no fuel costs, generating electricity from wind is more expensive than more conventional means of generation like natural gas and coal primarily because the capital cost of the equipment is higher. This is generally true for most types of renewable energy. Another reason wind generated electricity currently costs more is that the energy found in wind is not as concentrated as it is in conventional gas and coal-fired processes. This means that more equipment is required to capture the same amount of energy.
- ◉ Can you give me a concrete example of how choosing wind power can help the environment?  
Currently, electricity in Minnesota and surrounding states is supplied primarily from large coal-burning power plants, natural gas-fueled turbines and nuclear power. When a wind turbine is added to the interconnected electric transmission system, the need for these other generators diminishes. That is, when a wind turbine is producing power, a fossil fuel burning plant will be scaled back and burn less fossil fuel. Buying 100 kWh of wind-generated power each month for a year has the same environmental impact as planting a half-acre of trees or not driving your car 2,400 miles. Buying 600 kWh each month for a year is like taking one car off the road for a year.
- ◉ Do the specific electrons generated at Fairmont, MN come to my house?  
No. Electricity naturally flows from the source of generation to the nearest user. This means that customers near Fairmont will probably receive the electrons from the wind turbine. But the impacts of the generation will reach you.

Think of the interconnected electric transmission system used to transport electricity as a large pool. This system is often referred to as the "grid". Electric generators put power into the pool at hundreds of locations across the Northern Plains and consumers take power from the pool at their homes and businesses. Generators operate to keep the pool full, but in balance (not overflowing) at all times. That means that when one generator is added, another needs to turn off.

Major areas of the grid are carefully monitored to keep from overflowing or under-filling the power pool. When the wind power turbine generates power and pours it into the pool, or grid, other generators in Minnesota will be turned down or off to maintain the balance. Most power produced in Minnesota comes from coal-fired plants and that means that the power that flows in the regional grid will have a lower proportion of coal and a greater proportion of wind power.